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A Case Study: Effect of industrial effluent contaminated water disposed in Chambal River on irrigation land

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Abstract - *As India is an agricultural growth based economy and it is of prime importance to have a view on effect of effluent waste water on irrigation land, its adverse and beneficial effect on soil fertility, seeds germination and crop yield. This study is to present scarcity of water in irrigation and reuse of industrial effluent from river cause accumulation of N, P, K, heavy metals (Na^+, Ca^{++}, Mg^{++}, K^+ and Fe), Chloride, Ammonia and Total Dissolved Solids. This caused a long term effect on soil fertility but along with it is also have some positive effect likewise contaminated river water contains high NPK in it, which meets the fertilizer needs.*

The study focused on the area nearby Chambal river in Madhya Pradesh Region from Nagda [23.453°N 75.415°E] downstream to Gandhi Sagar Dam [24°42'24"N 75°33'12"E] upstream. Where nearby industrial effluent waste water discharged into the Chambal River and irrigation in this area mainly depends on the reuse of Chambal river water in summer and winter season.

Key words: - *Industrial Effluent, Waste Water, Chambal River, Soil, Crop.*

1. INTRODUCTION

Recently the scarcity of water leads to the overexploitation of groundwater for agriculture result in falling water table in Malwa Region. It is an important issue to find new resources of water for irrigation and reuse of river water. Industries near river bank discharged their effluent into fresh water without any adequate treatment (Bharti *et al.*, 2013). Reuse of industrial waste water provides an alternate source of water and nutrients in it are beneficial to accelerate growth of crops, which in turn helps farmers economically by reducing chemical fertilizer use (Xi *et al.,* 2014).

Chambal River like most rivers in India plays an integral role in the lives of thousands of communities living along the banks of the river. The river has approximately a span of 400 km in Madhya Pradesh. Old mythological name of this large river is Charmanyawati. River Chambal, a principle tributary of River Yamuna, originates in the Vindhyan ranges from Manpur near Mhow in Indore district of Madhya Pradesh at East longitudes 73°20" and North latitudes 22°27" at an elevation of 354 meter from sea level. It enters Rajasthan near Chourasigarh & flow through Kota, Sawai Madhopur, and Dholpur Districts over a length of 376 Km. Chambal finally enters in Uttar Pradesh and meets Yamuna River.

Soil health may be define from crop production point of view, a healthy soil is one that produces good crops suitable for human and animal consumptions and has the ability to recuperate to sustain production (Chhonkat et al., 2000). Apart from valuable nutrients some contaminants causes potential risk to soil fertility. Irrigation with water may also have impact on soil parameters such as pH, salinity, cation exchange capacity, buffering capacity, permeability, porosity, toxic contaminants, macro and micro nutrients for plant growth. Soil quality depends not only on the properties and components of irrigation water, but also on the soil characteristics, such as soil type nutrient condition and concentration of heavy metals (Xi *et al.,* 2014, Sharma and Kaur, 2014, Ambika et al., 2010).

Major crops that are cultivated in this region comprise of wheat, Maize, Sorghum among cereals, Gram, Tour, Urad and Moong among pulses, while Soyabean, Groundnut and Musturd among oilseeds. Horticulture crops like Onion, Garlic, Ladyfinger, Cabbage, Pumpkin, Brinjal, Cauliflower and Chilli among fruits like Papaya, Watermelon, Melon and Cucumber. In some parts narcotic crop Opium is also cultivated.

This study is carried out in the area along Chambal River from Nagda, a city situated 59.5 km away from holy city Ujjain, to Gandhi Sagar Dam in Mandsaur District. Near river bank there are various types of industries such as fertilizer, textile, cement, sugar, dye, steel/iron furnishing industries, small scale treatment and production industries (distillery, dairy, chemical and pesticides). Effluents from these industries contain N, P, K, heavy metals, organic and inorganic pollutants and toxic colors. This may affect the quality of fresh river water, soil health and ground water and plant tissues of the region.

Thus, we have to study water quality parameters of Chambal River like pH, Temperature, Turbidity, Total Alkalinity, Total Hardness, Electrical Conductivity (EC), Transparency, Total Dissolved Solids (TDS), Sodium, Potassium, Iron, Nitrate, Phosphate, Sulphate, Ammonia, Chloride, DO, BOD and COD and also soil quality parameters like pH, EC, Organic Carbon, N, P, K, Na+, Ca++, Mg++, K+ and Fe.

2. RELEVANT LITERATURE

2.1 Effect of effluent on Chambal River Water

Pipraiya et al., (2017) studied the physico-chemical characteristics of Chambal River water at three selected location for sampling as Kota (Rajasthan), Dhoulpur(Rajasthan) And Bhind-Etawa border during winter and summer season (2014-15). Compared water quality parameters like pH, alkalinity, DO, chloride, BOD, COD, Total hardness, Electrical conductivity (EC) and calcium, with IS 10500:2012 and also checked the changes occurred from last research carried out on same river. Concluded that some parameters like DO require keen attention at selected sampling station Kota. Strict attention is required for quality of discharged effluent from industries at station Kota.

Reddy P.B. (2017) this study provides base line information to find out influence of water quality on primary phytoplankton productivity, which is indicator of toxicant contamination. His major findings are Temperature changes from 19.2-24.8^{0}C, Transparency 22.4-12.9cm, DO 7.2-5.1 mg/l, Phosphate 0.02-1.1 mg/l, Nitrate 50.1-421.2mg/l, Sulphate 19.2-121.5 mg/l and Net Primary Productivity reduced from 0.145-0.074. This shows pollution of river water and concluded regular supervision of the water quality is recommended to prevent the pollution in this segment of the River.

Gupta et al., (2011), Investigated the Physico-chemical assessment of water quality ofriver Chambal in Kota city area of Rajasthan state (India) and find out the average of three year (2007-2009) water quality parameter as pH 7.5-8.25, Turbidity 3.9-8.2 NTU, Total alkalinity 112-148 mg/l, Total Dissolved Solids (TDS) 180-219 mg/l, Total hardness 132-146 mg/l, Chloride 14.9-18.9 mg/l, Nitrate 10.6-36.5 mg/l, Sulphate 13.4-26.4 mg/l, Sodium 16.6-34.6 mg/l, potassium 2.6-3.8 mg/l, Iron 0.11-0.18 mg/l, Ammonia 0.12-0.75 mg/l, DO 4.3-6.1 mg/l, COD 7.40-38.80 mg/l, BOD 1.20-12.20. Concluded that increased amount of Ammonia, BOD, COD and low DO shows river is moderately polluted at Kota.

Reddy et al., (2012), worked on the impact of waste water of Chambal River and biomarker responses in fish due to pollution. Analyze water quality, responses of fish against waste water (by Histological, hematological and bio chemical studies of fish). The major findings of this study are that heavy metals present in industrial effluent are more toxic and caused liver damage. Water from sampling station is not free from pollution and cannot be used for domestic purposes, drinking and even for agriculture.

2.2 Effect of waste water reuse on crop and soil health

Reddy P.B. et al. (2014) Investigated the water and soil sample at Nagda selecting three sampling station, one pollution free station upstream as reference station and other two stations downstream as polluted station. Analyzed the wide variation of waste water and soil parameters as pH changes from 7.7-10.1, Ca^{2+} 11.9-99.1mg/l, Mg^{2+} 5.6-8.9 mg/l, Na^{2+} 22.1-38.2mg/l, K^{+}0.5-4.5mg/l, potassium 16.1-57.0kg/ha, phosphorus 0.44-1.80 kg/ha, nitrogen 122-149kg/ha, organic carbon % 2.2-65 and EC 0.55-1.14mmhos/cm. They concluded that industrial effluent has significantly changed the water quality of Chambal River at Nagda as expected due to a wide spectrum of dyes manufacturing sources and due to presence of dyes and chemical in Textile effluent.

Sahare et al., (2014) investigated the physiochemical parameter of industrial effluent, ground water and soil (receiving and not receiving effluent) and suggested some possible solutions of problem that are proper land disposal of waste, dilution of sewage water in irrigation, use of zeolite and raising hyper accumulator plant.

Ambika et al., (2010) Shows that Crop growth and Soil properties affected by Sewage Water Irrigation and concluded that irrigationwater quality is one of the main factors limiting the plant growth. Sewage water often have a high nutrient load, suspended solids, dissolved nitrates, pesticides, heavy metals and many other toxic materials / chemicals which may be hazardous and it may affect the soil micro-flora, soil texture and quality and also the plant growth and development. Effect of its direct and long term use for irrigation needs thorough study.

Chhonkar et al., (2000) studied the effect of distillery and paper mill effluent on soil health, crop and water bodies and concluded that industrial effluent is characterized by high BOD and COD and contain high percentage of different organic and inorganic materials. This impacts agricultural land as well as environment.

Sharma and Kaur, Review the literature relevant to soil health and listed the effect of effluent at different places over soil characteristics. It shows dye industries effluent at Ujjain MP, India contains high amount of chlorides which deteriorate soil quality.

Roy et al., (2013), worked on industrial waste water effect on crop and concluded that farmer's when goes towards fertilizer cost savings but toxicity of waste water bring about their economic losses. It increased pesticide cost and weed problem. Although it increased growth of crop but reduced grain yield and delayed maturities. It also increased crop diseases and soil pollution. It is not favorable inn green environment, socioeconomic condition and sustainable development.

3. CONCLUSION

Above study shows that industrial effluents degrades the soil quality and water quality of fresh Chambal River water. The irrigation with this water affects the crop and there are some possible solutions of this problem associated with industrial effluent.

- Diluted textile effluent may be used for crops without affecting soil quality.
- Application of ventury setup in drip or sprinkler irrigation where zeolite/ kaolin filters can be added to reduce the heavy metal availability to soil.
- The concerning government bodies has to spread awareness and represent a modal to use bio-fertilizer, which boost the yield potentials as well as decreases the metal availability to plants.
- Cultivating horticulture plants like sevanthi, marigold, isabgol and guar gum help in improving soil quality.
- Fruit plants and trees like Orange, Jack Fruit, Jujube Fruit, Guava and Pomegranate should be cultivated because it gives long term productivity and regular crops can cultivated between their rows.
- Some new crops which absorb heavy metals and reduce heavy metal concentration in soil may be cultivated.
- Continuous monitoring of industrial effluent must be done to avoid excessive accumulation of heavy metals.
- Farmers has to try some small scale practices like first collect waste water into a well and treat it with ammonia liquor and sulfuric acid, which settle the slurry at bottom as ammonium sulphate(can further be used as fertilizer or treating agent) and then use this treated water in irrigation.

It is concluded from above literature that there is need of research on micro and macro nutrient requirement of crops, soil microbial and enzymatic activity and to develop some models for irrigation to mitigate the effect of effluent on soil and crop, which in turn leads to sustainable development.

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